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(54) **ELECTRICAL CONNECTOR WITH A SLIDER**

(57) The present invention relates to an electrical connector (1) comprising: a connector housing (10) with a mate-assist slider (30), where the mate-assist slider (30) is arranged movable along guide portions of the connector housing (10), and a mate-assist lever (50), adapted to interact with the mate-assist slider (30). The mate-assist lever (50) is rotatably mountable on the connector housing (10) to facilitate the mating procedure with a corresponding counter connector (3). The outer surface of the mate-assist slider (30) is provided with a stopping member (32) that is arranged to engage a corresponding stopping portion (14) of the connector housing (10) when the mate-assist slider (30) is disposed along the guide portions (12) and blocking further movement of the mate-assist slider (30) in at least one direction. Further, the mate-assist lever (50) comprises release means (60) that are adapted to release the stopping member (32) when the mate-assist lever (50) is mounted at a first position on the connector housing (10).

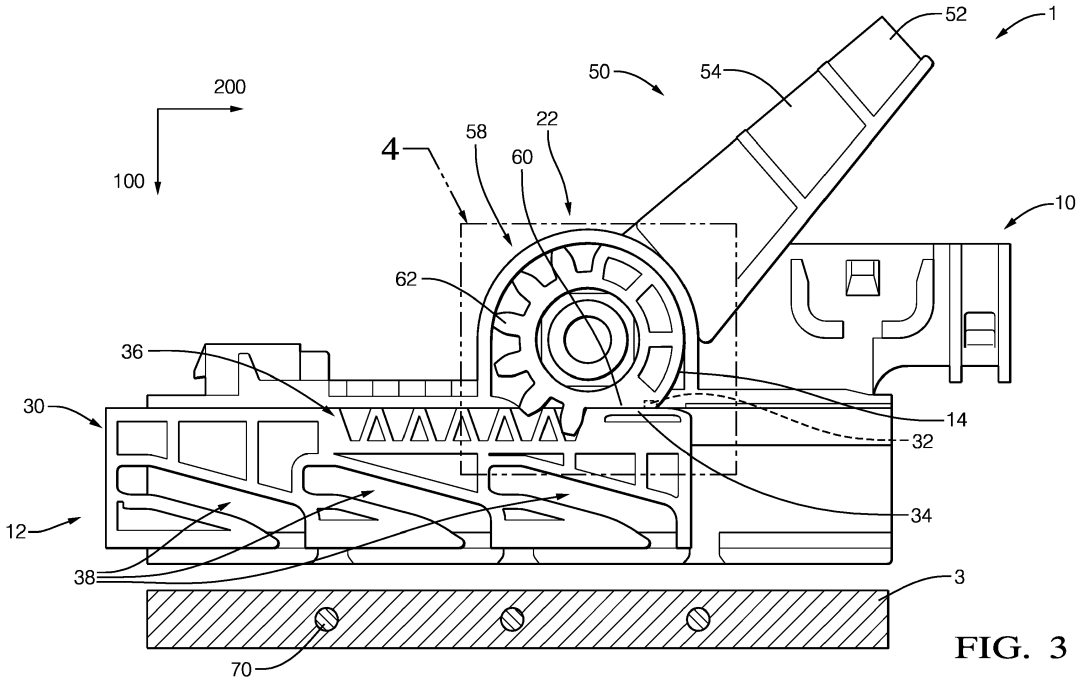

FIG. 3

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Description

1. Field of invention

[0001] The present invention relates to an electrical connector and in particular to an electrical connector comprising a slider with a stopping member which is releasable upon lever assembly.

2. Technical background

[0002] Electrical connector systems are used for joining electrical circuits, wherein typically a male contact terminal is mated with a female contact terminal. The terminals are arranged in respective connector housings to allow a safe and reliable mating process. In many applications, a particularly safe and reliable coupling of contact terminals is of high importance. In some connector applications a large amount of terminals and/or space constraints make it difficult for the technician in an assembly process to apply sufficient (manual) force to the connector housings in order to achieve a full mating. This is for example often the case in automotive applications, where electrical connections need to be reliably established at locations which are difficult to access, like for instance behind dashboards. In such cases the mating process can be facilitated by providing the connector housings with mate-assist devices, for example with mate-assist levers or sliders.

[0003] The patent application WO 2006/101816 A1 shows a typical connector assembly, comprising a mate-assist lever, wherein the rotational movement of the mate-assist lever leads to an engagement of the connector with a counter connector to establish an electrical connection. A first mechanical lock in form of a cantilever latch and a catch is provided, which prevents the lever from moving out of the mated position. Additional mating safety is provided by a CPA device (Connector Position Assurance device), which is slidably guided on the top surface of the connector housing.

[0004] Another connector using a mate-assist system but with a sliding design is shown in the patent application WO 2010/076592 A1. In here, the mate-assist device can be linearly pushed towards and into a corresponding connector housing. The mate-assist device comprises cam slots in its walls and in the corresponding counter connector housing complementary cam pegs are arranged such that a sliding movement of the mate-assist device leads to an interaction of the cam pegs with the cam slots. This leads in effect to a relative movement of the two connector housings towards each other. In other words: The actuating or working direction of the mate assist-device is a translatory movement perpendicular to the mating direction of the two connector housings. A flexible blocking wing acts as a stop member, and prevents actuation of the mate-assist device unless the second connector housing is at least partially mated with the first connector housing. To improve security of the mated connection, latching recesses are provided, which snap into corresponding protrusions when the insertion of the mate-assist device into the connector housing is finished.

[0005] Another connector using a mate-assist system with a combined mate assist lever and mate-assist slider is shown in the European patent application EP 0 273 999 A2. In here a connector arrangement with a plug housing and a socket housing is shown, wherein one housing contains plug contact elements and the other socket contact elements. Further on one of the two housings there being arranged at least one toothed rod which can move at right angles to the direction of insertion and engages with a pinion region of a pivoting operating lever. The lever is pivoted such that it can rotate about the pinion axis between an open position and a closed position. Further, the toothed rod is provided with at least one cranked slot and at least one cam projection which is provided on the other housing to engage with said projection in assembled condition.

Another connector using a mate-assist system with a combined mate assist lever and mate-assist slider is shown in the European patent application EP 0 933 836 A2. In here a connector has a camming slide slidably mounted on a connector housing. The camming slide has a lever arm, pivotally mounted with a pinion engaging a toothed rack provided on the housing to achieve particularly low forces that need to be applied by an operator for mating connectors. The slider comprising an open position for receiving a complementary connector and a closed position where the connector is in a fully mated engagement with the counter connector.

[0006] According to the state-of-the art, positioning of the mate-assist sliders in electrical connector systems before assembly of the mate-assist lever or before initiation of the mating process is usually safeguarded by interacting means in form of openings engaging corresponding protrusions provided at the walls of the connector housing and the mate-assist slider. Further, mate-assist levers are usually assembled by flexible means to the connector housing.

[0007] However, by providing openings in the walls of the corresponding parts, for instance the connector housing or the mate-assist slider, the stability of the housing or slider is reduced. Further, the addition of multiple means for ensuring the positioning of the corresponding parts during assembly and mounting procedure usually increases complexity of the connector and further complicates the assembly of the connector and the mating procedure. Even further, lever attachments by flexible means only provide a relatively weak connection between the lever and the housing so that additional fixation means needs to be provided to achieve sufficient fixation between the mate-assist lever and the connector housing.

[0008] Thus it is an objective of the present invention to provide an improved electrical connector with increased safety and an facilitated mounting and mating process.

3. Summary of the invention

[0009] The above objectives are achieved with an electrical connector according to claim 1.

[0010] The present invention relates to an electrical connector comprising a connector housing with a mate-assist slider, where the mate-assist slider is arranged movable along guide portions of the connector housing, and a mate-assist lever, adapted to interact with the mate-assist slider, wherein the mate-assist lever is rotatably mountable on the connector housing to facilitate the mating procedure with a corresponding counter connector. The outer surface of the mate-assist slider is provided with a stopping member, that is arranged to engage a corresponding stopping portion of the connector housing when the mate-assist slider is disposed along the guide portions. The stopping member can block further movement of the mate-assist slider in at least one direction, and the mate-assist lever comprises release means that are adapted to release the stopping member when the mate-assist lever is mounted at a first position on the connector housing. The electrical connector presented herein fulfil the requirement of an unambiguous defined position of the mate-assist slider and the mate-assist lever at the start of the mating process. The clearly defined starting position of the mate-assist slider can facilitate the mating process as it prevents initiation of the mating process as long as the mate-assist slider is in an unfavorable position. As the connector can comprise a multitude of electrically conductive terminals, it can be understood that, with an increasing terminal number, an increased force must be applied to mate said connector with its counterpart. Also it is obvious that a correct alignment of said connector can be difficult, in particular, when the corresponding parts have small dimensions due to a compact design of the connector. Hence, the mate-assist slider can be used to guide and facilitate the movement of said connector. The mate-assist lever can be for example rotationally hinged with the connector housing. Thus, the rotational movement of the mate-assist lever can be translated to a translational movement of one connector towards its counterpart. The interaction of slider and lever is principally known to the skilled person and for example described in the above referenced prior art documents, the contents of which are herein incorporated by reference.

[0011] Since the slider is blocked by an engagement of the stopping member of the slider and the corresponding stop portion of the housing it is ensured that the slider can just be moved up to a clearly defined position, which does not need to be controlled visually or in any other way by a user. This facilitates the assembly of the whole connector. Further the stopping member can only be released by a correctly mounted lever. Thus the correct assembly of the electrical connector is safeguarded for both components and mating cannot be initiated, if not both components were assembled in the correct manner.

[0012] In a preferred embodiment, the mate-assist lever can be rotated to a second position, thereby moving the mate-assist slider along the guide portions, wherein in the second position mating of the electrical connector with the corresponding counter connector can be initiated. Allowing the initiation of the mating process at a second position of the mate-assist lever after rotation provides the advantage that mating can only be started when the above described stopping member was successfully disabled. This is only the case if both components, the mate-assist lever and the mate-assist slider are assembled in a correct fashion. Otherwise further slider movement would be blocked by the active stopping member. This verification of correct assembly gives a user a direct feedback (namely, the lever does not move) without the need for visual or acoustic feedback, which facilitates the assembly process.

[0013] In another preferred embodiment, the mate-assist lever can be rotated to a third position, wherein the electrical connector is fully mated with the corresponding counter connector. Thus the rotation of the lever to the third position provides a visual indication that the mating process between a connector and a corresponding counter connector was successful. Preferably the mate-assist lever cannot be moved further so that the final mating position of the lever and thus the slider and accordingly the correct and successful mating between the connector and the counter connector is clearly recognizable.

[0014] In another preferred embodiment, the guide portions comprise at least one channel inside the connector housing adapted to receive the mate-assist slider at least partially and wherein one channel wall is formed by an outer wall of the connector housing. Guiding the mate-assist slider inside a channel adapted to receive and guide the mate-assist slider provides the advantage of proper guidance of the movement of the mate-assist slider during the mating process. Guiding the mate-assist slider inside the housing prevents the mate-assist slider from being impacted by outside forces, which could alter the position of the mate-assist slider and hence impacting the mating for of the instance electrical contacts of the connector and the counter connector. Further, the mate-assist slider can be protected inside the channel from any mechanical or environmental influences like for instance moisture and dirt/dust, which could negatively impact a smooth mating procedure.

[0015] In another preferred embodiment the outer wall of the connector housing does not comprises any openings. The electrical connector is formed preferably mechanically stable and robust. Openings naturally mark weak points, which can easier break or deform, compared to a uniformly designed component. Thus the renouncement of any destabilizing open portions within the walls of the connector increases robustness of the connector assembly, which accordingly increases reliability of the established connection, since the whole assembly is less susceptible against hits or vibrations as they could occur for instance when the connector is used in a car.

[0016] In another preferred embodiment the stopping

member is a blocking protrusion located at an edge of the mate-assist slider that in assembled condition is directed towards the mate-assist lever. Forming the stopping member as blocking protrusion simplifies the manufacturing of the mate-assist slider, since it can be integrally formed with the mate-assist slider and thus be formed as molded in one piece. Further the arrangement of the protrusion on the top of the mate-assist slider simplifies the assembly of the connector as the contact between the blocking protrusion and the mate-assist lever can be directly established by the mounting of the mate-assist lever. The protrusion can be blocked by a simple contact wall of the housing without the need of providing any further means of engaging the stopping member.

[0017] In another preferred embodiment the mate-assist lever comprises a U-shape with an integral lever web and two lever arms, attached at opposite ends of said web, wherein the distal ends of the lever arms each comprise a lever mounting portion at which the mate-assist lever can be mounted to the connector housing. The U-shape provides an increased mechanical stability of the mate-assist lever. Said increased mechanical stability also allows choosing materials with reduced rigidity for the mate-assist lever, hence leading to additional freedom in the selection of appropriate materials for manufacturing said mate-assist lever. It is further preferred, that the U-shaped mate-assist lever is produced in a one-piece design, for example as one molded plastic part.

[0018] In another preferred embodiment the lever mounting portion comprises the release means, which is formed to engage with the stopping member. These means engage the stopping member when the lever is mounted in a correct fashion to the connector housing. For instance a flat surface, provided on the lever can function as release member. When the mate-assist lever is mounted, the surface can engage a corresponding surface at the top of the mate-assist slider. Thus the surfaces can align accordingly along each other, hence ensuring that the mate-assist lever is in a defined orientation.

[0019] In another preferred embodiment the stopping member is arranged on a flexible web that is integrally formed with the mate-assist slider, to allow an elastic disposition of the stopping member by the release means of the mate-assist lever. An integral formation allows easy manufacturing of the slider, since it can be produced in a one-piece design, preferably as a molded single piece. The elastic disposition allows a multiple time use of the stopping member.

[0020] In another preferred embodiment the mate-assist lever is provided with a lever pinion and the mate-assist slider is provided with a corresponding slider rack, to achieve a rack and pinion type actuating mechanism between mate-assist lever and mate-assist slider. The engagement of the gears of the slider rack with the gears of the lever pinion allows a translation of the rotational lever movement to a corresponding translational movement of the slider. Both parts are preferably manufactured that they engage each other, when the mate-assist lever is mounted to the connector housing. Turning of the mate-assist lever from the first, lever mounting position, into the second position leads to a translational movement of the mate-assist slider along the guiding means, provided at the connector housing to guide the movement of the mate-assist slider. Thus a potentially small translational movement of a mate-assist slider can be controlled by a potentially larger rotational movement, which can be designed as desired, dependent on the length of the lever arms and the design of the lever pinion.

[0021] In another preferred embodiment the connector housing comprises at least one circular sleeve extending perpendicular from an outer wall of the connector housing, the circular sleeve adapted to receive a pivot pin provided on the mate-assist lever and comprising cylindrical inner walls and a sleeve end portion integrally formed with the outer wall of the connector housing, and at least one guiding rib, protruding circumferentially along the cylindrical inner walls, and spaced apart from the sleeve end portion along the extension direction of the circular sleeve, so that a circumferential gap is formed between the guiding rib and the sleeve end portion, undercutting the at least one guiding rib and adapted to receive a corresponding protrusion provided on the pivot pin, wherein the guiding rib comprises at least one insertion recess through which the protrusion can be inserted into the undercut gap during assembly of the mate-assist lever. The mate-assist lever can only be mounted on the housing at a distinct position and orientation. This position can be defined by several means, provided at the connector housing, for instance the above mentioned circular sleeve, which allows that a corresponding pivot pin of the mate-assist lever is received. The pin can enter the sleeve coaxially to the extension direction of the sleeve in a way the rotational axis of the mate-assist lever is formed around which said mate-assist lever can be turned. However, insertion of the lever pin is only possible when the protrusion, formed at the pin, is entered in the insertion recess. This ensures that the mate-assist lever can only be mounted when it is in the correct orientation, namely in the first position. Rotational movement of the lever is blocked by the walls of the insertion recess, as long as the pin is only partially inserted. After complete insertion the mate-assist lever is assumed to be correctly mounted in the first position and the mate-assist lever can be turned around the rotational axis to the second position. A clear definition of the degrees of movement of all parts in each step during assembly and the mating procedure reduces susceptibility of the connector assembly against user based mistakes.

[0022] In another preferred embodiment the protrusion is guided in the undercut gap during the rotational movement of the mate-assist lever, preventing a disengagement of the mate-assist lever. Thus, the rotational movement of the mate-assist lever is guided in a plane perpendicular to the rotational axis. The guidance of the protrusion in the undercut circumferential gap prevents the mate-assist lever from being disassembled during and

after the mounting procedure, which increases robustness and reliability of the connector assembly.

[0023] In another preferred embodiment the guiding rib and the protrusion are formed to be rigid and stiff. Thus, engagement of the protrusion and the walls of the guiding rib achieve a higher mechanical robustness compared to any design where the fixation of the mate-assist lever to the connector housing is performed by flexible means. Also no further fixation means are needed to obtain a proper fixation of the mate-assist lever, which simplifies the mounting procedure. Also less flexible materials can be chosen to manufacture the lever and the connector housing. Further the design, for instance dimensioning of the protrusion and the rib, can be as desired, since there is no limitation that any part must comprise a certain flexibility.

[0024] In another preferred embodiment the mate-assist slider comprises at least one cam slot to receive at least one corresponding cam follower of the counter connector. The cam follower can be provided at the outer surface of the counter connector housing, for instance as outer protrusions. Correspondingly, the cam slots can be formed in the outer walls of the mate-assist slider. The cam slots can be arranged so that the guidance of the cam follower in the cam slots during the translational movement of the mate-assist slider lead to a translational movement of the cam follower, perpendicular to the movement of the mate-assist slider. Hence, when the mate-assist slider is moved perpendicularly to the mating direction, for instance horizontally, the cam follower and accordingly the counter connector move vertically along mating direction, thus establishing the electrical connection. This has the advantage that, dependent on the design of the cam slots, a small translational slider movement can be translated to a large translational movement of the counter connector, or vice versa, as desired.

[0025] In another preferred embodiment the electrical connector is a standard High Density Connector (HDC) connector. The above described connector is in particular interesting for electrical connectors in cars, which require a particular reliability in connectivity and robustness of the connector.

4. Description of the drawings

[0026] For a better understanding of the present invention and to appreciate its practical applications, the following figures are provided and referenced hereafter. It should be noted that the figures are given as examples only and in no way limit the scope of the invention.

Fig. 1 shows a cross section of the connector with assembled mate-assist slider.

Fig. 2 shows a close up view of the connector comprising the circular sleeve for mounting the lever and assembled mate-assist slider.

Fig. 3 shows a cross section with of the connector with assembled mate-assist slider and mounted mate-assist lever in first position.

Fig. 4 shows a close up view of the cross section of the connector with assembled mate-assist slider and mounted mate-assist lever in a first position

Fig. 5 shows a cross section of the mate-assist lever.

5. Description of preferred embodiments

[0027] In the following the present invention will now be described in more detail hereinafter with reference to the accompanying figures, in which exemplary embodiments of the invention are illustrated. However, the present invention may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these examples are provided so that this disclosure will be thorough and will convey the scope of the invention to persons skilled in the art.

[0028] **Fig 1.** Shows in a cross-sectional view a preferred embodiment of the invention, namely an electrical connector 1, which can be mated with a corresponding counter connector 3 to establish a mechanical or electrical connection along a mating direction 100. To protect the housed electrically conducting parts from physical damages or ingressing moisture the electrical connector 1 comprises a connector housing 10, which is usually made of an insulative material, such as plastic. Fig. 1 depicts the electrical connector 1 in a condition where the mate-assist lever 50 is not yet mounted to the connector housing 10. The mating process of the electrical connector 1 can be facilitated by a mate-assist slider 30 in connection with the mate-assist lever 50 to be mounted. Similar to the connector housing 10, also the mate-assist slider 30 can be produced from an insulative material such as plastic to protect housed electrically conductive parts from damages. Both, the connector housing 10 and the mate-assist slider 30 are each preferably integrally formed, for instance as single molded parts to obtain increased mechanical stability. The movement of the mate-assist slider 30 is guided by guide portions 12 along the connector housing 10. The translational movement of the mate-assist slider 30 is guided along a lateral direction 200 that is perpendicular to the mating direction 100.

[0029] The guide portions 12 in this embodiment are channel-like and formed such that the mate-assist slider 30 can be tightly received by said channel in a way that the movement of the mate-assist slider 30 is limited to a movement coaxially to the lateral direction 200. Thus any unintended movements of the mate-assist slider 30 can be prevented. The mate-assist slider 30 can be guided in the connector housing 10 along a lateral direction 200 until a stopping member 32 engages a corresponding stopping portion 14 of the connector housing 10 and prevents further lateral movement of the mate-assist slider

30. Thus, according to the engagement, the mate-assist slider 30 is in a clearly defined position relative to the connector housing 10. Since the stopping member 32 sufficiently blocks the movement of the mate-assist slider 30, no further means are needed to keep the mate-assist slider 30 in the desired position. This preferably allows waiving of additional recesses provided at the connector housing 10 or mate-assist slider 30, which provision reduce mechanical stability.

[0030] At least one cam slot 38 is arranged within the mate-assist slider 30, which is formed to receive a corresponding cam follower 70, provided at a counter connector 3. Upon a lateral movement of the mate-assist slider 30, the inclined extension of the cam slots 38 within the wall of the mate-assist slider 30 leads to a movement of the cam follower 70 within said cam slots 38, coaxially to the mating direction 100, which results in an approaching of the counter connector 3 and the electrical connector 1. Thus, electrical connection of any housed conductive parts of the electrical connector 1 and the counter connector 3 can be safely established since the movement of said parts is delimited by the guided movement of the mate-assist slider. The one or more cam slots 38 comprise an opening at the side facing the counter connector 3, where the one or more cam followers 70 can enter the corresponding cam slots 38.

[0031] The electrical connector 1 of the embodiment depicted in Fig. 1 is in a condition, where the mate-assist slider 30 is blocked by a stopping member 32, which engages a corresponding stopping portion 14 at the connector housing 10. As a consequence, the opening of the cam slot 38 is inaccessible for the cam follower 70 because the openings are blocked by the wall of the connector housing 10. Thus a mating of the electrical connector 1 and counter connector 3 without a properly assembled mate-assist lever 50 is prevented. The stopping member 32 can be integrally formed and located on the top surface of the mate-assist slider 30. Elastic depositioning of the stopping member 32 can be enabled by providing a recess under the stopping member 32 in the wall of the mate-assist slider 30, thus forming a flexible web 34 at the upper surface of the mate-assist slider 30. Thus, the stopping member 32 can be pushed towards mating direction 100 during mate-assist lever 50 assembly.

[0032] The connector housing 10 further comprises a housing mounting portion 22 at which a mate-assist lever 50 can be mounted. The housing mounting portion 22 is located such that a mate-assist lever 50 can be mounted in the vicinity of the mate-assist slider 30. The housing mounting portion 22 comprises a circular sleeve 16 which comprises a sleeve end portion 28 and one or more guiding ribs 18, formed to receive and guide a corresponding male counterpart of the mate-assist lever 50 in order to rotatably hinge the mate-assist lever 50 with the connector housing 10. The upper portion of the mate-assist slider 30, which faces the housing mounting portion 22 also comprises a slider rack 36 formed to engage with a corresponding lever pinion 62 of the mate-assist lever 50.

[0033] **Fig. 2** shows a close up side view of the housing mounting portion 22 as shown in Fig. 1. The circular sleeve 16 is formed by the outer wall of the connector housing 10 and is adapted to receive a corresponding male counterpart, such as a pivot pin 66 provided at the mate-assist lever 50. The circular sleeve 16 comprises cylindrical inner walls 26 and a sleeve end portion 28. Thus, insertion of the pivot pin 66 can be guided along the cylindrical inner walls 26 of the circular sleeve 16. The pivot pin 66 is depicted in Fig. 5. This ensures a proper mounting of the mate-assist lever 50 at the connector housing 10. Furthermore, guiding ribs 18 are formed, protruding circumferentially along the cylindrical inner walls 26 and spaced apart from the sleeve end portion 28 along the extension direction of the circular sleeve 16 so that a circumferential gap 24 is formed between the guiding ribs 18 and the sleeve end portion 28, thus undercutting said guiding ribs 18. The guiding ribs 18 comprise at least one insertion recess 20 through which a corresponding protrusion 64, provided at the pivot pin 66, can be inserted. The insertion recess 20 is formed to tightly receive the protrusion 64 so that the protrusion 64 is guided during the assembly of the mate-assist lever 50 in direction towards the sleeve end portion 28. This prevents the mate-assist lever 50 from being assembled in an unwanted position. Once the protrusion 64 has passed the insertion recess 20, it also can be rotatably moved along the undercut circumferential gap 24. The guiding rib 18 delimits the movement of the protrusion 64 to a rotational movement and thus prevents the mate-assist lever 50 from being disassembled from the connector housing 10 after it was moved out of the first position. Is it of advantage when the guiding ribs 18 are rigid and stiff and are sufficiently robust dimensioned so that they can provide an improved mechanical stability. Thus, no further means are necessary to safeguard the mate-assist lever 50 at the connector housing 10, which simplifies the mounting procedure. In Fig. 2 also a part of the mate-assist slider 30 is shown. As in Fig. 1, the stopping member 32 engages the corresponding stopping portion 14 at the housing mounting portion 22 of the connector housing 10.

[0034] **Fig. 3** shows the electrical connector 1 with an assembled mate-assist lever 50 arranged in the first position. The mate-assist lever 50 is mounted at its lever mounting portion 58 to the connector housing 10 at the housing mounting portion 22. The mate-assist lever 50 is arranged such that it can easily be grabbed by a user at the integral lever web 52 and subsequently rotatably moved. The integral lever web 52 is connected with the lever mounting portion 58 by a lever arm 54. As depicted, the mate-assist lever 50 comprises release means 60 at the lever mounting portion 58, which can be formed for instance as a flat surface in order to engage the stopping member 32, which can be formed for instance as a stopping protrusion that extends from the outer surface of the flexible web 34. As already discussed the mate-assist

slider 30 is in distinct position because of the engagement of the stopping member 32 and the corresponding stopping portion 14.

[0035] Upon mate-assist lever 50 assembly, the release means 60 deform the flexible web 34 elastically in a way that the stopping member 32 is pushed downwards. Hence the engagement of the stopping member 32 with the stopping portion 14 is released. Accordingly, further movement of the mate-assist slider 30 is only possible with a properly assembled mate-assist lever 50. This ensures that further mating can only be performed when the mate-assist lever 50 and the mate-assist slider 30 are both in a correct position.

[0036] The lever mounting portion 58 also comprises a lever pinion 62, which is formed to engage a corresponding slider rack 36. The engagement allows a rack and pinion type actuating mechanism, wherein the mate-assist slider 30 can be moved in lateral direction 200 along the guide portions 12 while the mate-assist lever 50 is turned. The mate-assist lever 50 can be subsequently turned to a second position, wherein the openings of the cam slots 38 are shifted such that they match the openings of the adjacent wall of the connector housing 10. In this second position mating between the electrical connector 1 and a counter connector 3 can be initiated and one or more cam followers 70 of the counter connector 3 can be received by the corresponding cam slots 38. After initiation of the mating process further rotation of the mate-assist lever 50 leads to a further translational movement of the mate-assist slider 30 along the lateral direction 200, which in turn leads to further movement of the cam followers 70 inside the cam slots 38 against mating direction 100. Accordingly, the electrical connector 1 and counter connector 3 are moved towards each other. When the mate-assist lever 50 has reached the third position, mating process of the electrical connector 1 and the counter connector 3 is completed and a mechanical or electrical connection is properly established.

[0037] **Fig. 4** shows a close up view of the lever mounting portion 58 formed at the distal ends of the lever arms 54 of the mate-assist lever 50 in a mounted condition at the housing mounting portion 22 of the connector housing 10. As depicted, the mate-assist lever 50 is in the first position, similar to the position shown in Fig. 3. As described above, the mate-assist slider 30 comprises a stopping member 32, which can be formed as a stopping protrusion on the top surface of a flexible web 34. Upon mate-assist lever 50 assembly, the release means 60 of the mate-assist lever 50 elastically deforms the stopping member 32, thereby releasing the slider 30.

[0038] **Fig. 5** shows a cross-sectional view of the mate-assist lever 50. The mate-assist lever 50 comprises a U-shape with two lever arms 54 (the lever 50 is formed symmetrical and only arm is visible in Fig. 5) and an integral lever web 52. Each lever arm 54 has a lever mounting portion 58 at its distal end, which is formed at the inner lever surface 56. The mate-assist lever 50 can be mounted at this lever mounting portion 58 to the corresponding housing mounting portion 22 of the connector housing 10. Further, one can see the release means. The mate-assist lever 50 further comprises the pivot pin 66 which is protruding from the inner lever surface 56 and is formed to be receivable by the corresponding circular sleeve 16. Two protrusions 64 are provided at the outer surfaces of the pivot pin 66, which are formed to be receivable by the corresponding insertion recesses 20 of the circular sleeve 16. The protrusions 64 are preferably formed to be rigid and stiff to achieve an improved mechanical stability. Once the pivot pin 66 is fully received by the circular sleeve 16, the mate-assist lever 50 can be subsequently rotated to the second and third position around the axis defined by the extending direction of the pivot pin 66. During rotation, the protrusions 64 are guided within the gap that is formed to undercut the guiding ribs 18, thus preventing the mate-assist lever 50 from being disengaged.

Reference signs

Overview

Part	#
electrical connector	1
counter connector	3
connector housing	10
guide portions	12
stopping portion	14
circular sleeve	16
guiding rib	18
insertion recess	20
housing mounting portion	22
gap	24
cylindrical inner walls	26
sleeve end portion	28
mate-assist slider	30
stopping member	32
flexible web	34
slider rack	36
cam slot	38
mate-assist lever	50
integral lever web	52
lever arm	54
inner lever surface	56
lever mounting portion	58
release means	60
lever pinion	62
protrusion	64
pivot pin	66

(continued)

Overview

Part	#
cam follower	70
mating direction	100
lateral direction	200

Claims

1. An electrical connector (1) comprising:

a connector housing (10) with a mate-assist slider (30), where the mate-assist slider (30) is arranged movable along guide portions of the connector housing (10), and
a mate-assist lever (50), adapted to interact with the mate-assist slider (30), wherein the mate-assist lever (50) is rotatably mountable on the connector housing (10) to facilitate the mating procedure with a corresponding counter connector (3);
characterized in that the outer surface of the mate-assist slider (30) is provided with a stopping member (32), that is arranged to engage a corresponding stopping portion (14) of the connector housing (10) when the mate-assist slider (30) is disposed along the guide portions (12) and blocking further movement of the mate-assist slider (30) in at least one direction; and wherein
the mate-assist lever (50) comprises release means (60) that are adapted to release the stopping member (32) when the mate-assist lever (50) is mounted at a first position on the connector housing (10).

2. The electrical connector (1) according to claim 1, wherein the mate-assist lever (50) can be rotated to a second position, thereby moving the mate-assist slider (30) along the guide portions (12), wherein in the second position mating of the electrical connector (1) with the corresponding counter connector (3) can be initiated.

3. The electrical connector (1) according to one of the preceding claims, wherein the mate-assist lever (50) can be rotated to a third position, wherein the electrical connector (1) is fully mated with the corresponding counter connector (3).

4. The electrical connector (1) according to one of the preceding claims, wherein the guide portions (12) comprise at least one channel inside the connector housing (10) adapted to receive the mate-assist slider (30) at least partially and wherein one channel wall is formed by an outer wall of the connector housing (10).

5. The electrical connector (1) according to the preceding claim, wherein the outer wall of the connector housing (10) does not comprises any openings.

6. The electrical connector (1) according to one of the preceding claims, wherein the stopping member (32) is a blocking protrusion located at an edge of the mate-assist slider (30) that in assembled condition is directed towards the mate-assist lever (50).

7. The electrical connector (1) according to one of the preceding claims, wherein the mate-assist lever (50) comprises a U-shape with an integral lever web (52) and two lever arms (54), attached at opposite ends of said web, wherein the distal ends of the lever arms (54) each comprise a lever mounting portion (58) at which the mate-assist lever (50) can be mounted to the connector housing (10).

8. The electrical connector (1) according to the preceding claim, wherein the lever mounting portion (58) comprises the release means (60), which is formed to engage with the stopping member (32).

9. The electrical connector (1) according to one of the preceding claims, wherein the stopping member (32) is arranged on a flexible web (34) that is integrally formed with the mate-assist slider (30), to allow an elastic disposition of the stopping member (32) by the release means (60) of the mate-assist lever (50).

10. The electrical connector (1) according to one of the preceding claims, wherein the mate-assist lever (50) is provided with a lever pinion (62) and the mate-assist slider (30) is provided with a corresponding slider rack (36), to achieve a rack and pinion type actuating mechanism between mate-assist lever (50) and mate-assist slider (30).

11. The electrical connector (1) according to one of the preceding claims, wherein the connector housing (10) comprises at least one circular sleeve (16) extending perpendicular from an outer wall of the connector housing (10), the circular sleeve (16) adapted to receive a pivot pin (66) provided on the mate-assist lever (50) and comprising:

cylindrical inner walls (26) and a sleeve end portion (28) integrally formed with the outer wall of the connector housing (10); and
at least one guiding rib (18), protruding circumferentially along the cylindrical inner walls (26), and spaced apart from the sleeve end portion

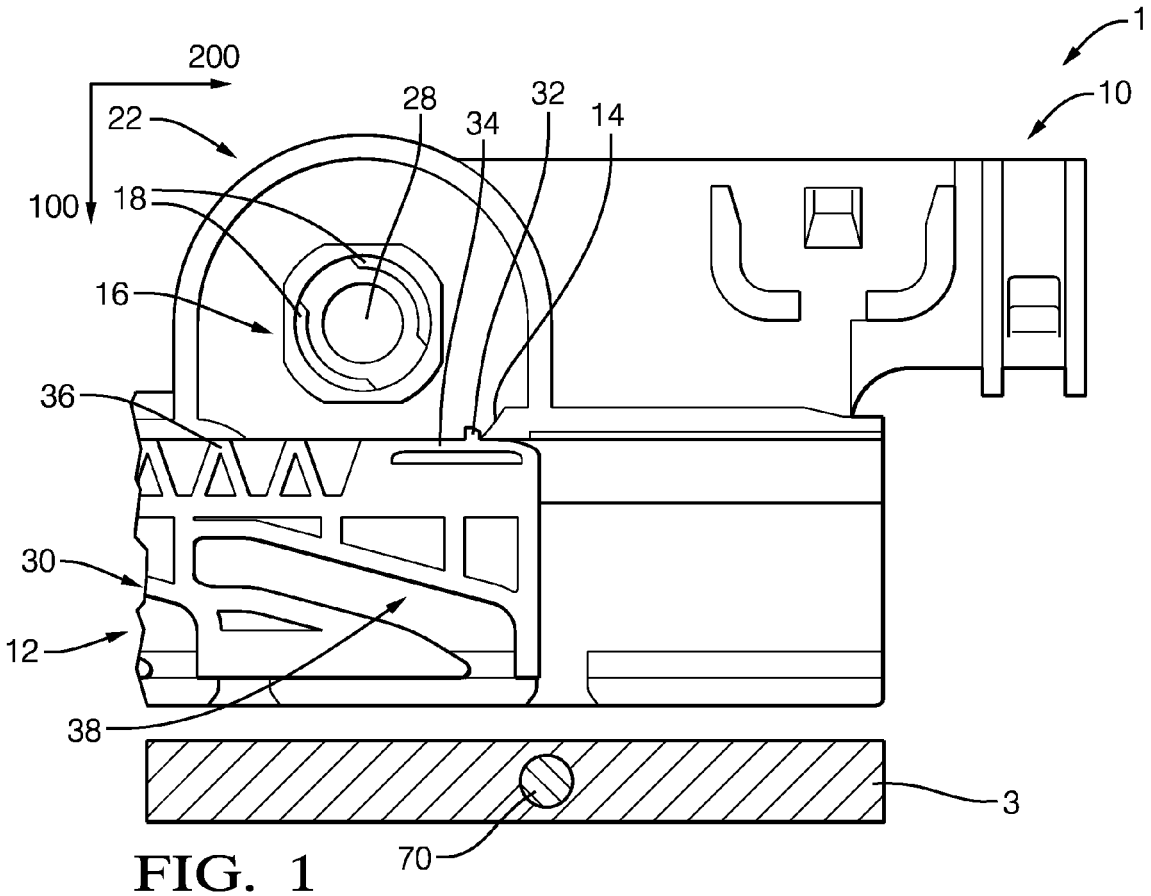
(28) along the extension direction of the circular sleeve (16), so that a circumferential gap (24) is formed between the guiding rib (18) and the sleeve end portion (28), undercutting the at least one guiding rib (18) and adapted to receive a corresponding protrusion (64) provided on the pivot pin (66), wherein the guiding rib (18) comprises at least one insertion recess (20) through which the protrusion (64) can be inserted into the undercut gap (24) during assembly of the mate-assist lever (50).

12. The electrical connector (1) according to the preceding claim, wherein the protrusion (64) is guided in the undercut gap (24) during the rotational movement of the mate-assist lever (50), preventing a disengagement of the mate-assist lever (50).

13. The electrical connector (1) according to one of the preceding claims 11 or 12, wherein the guiding rib (18) and the protrusion (64) are formed to be rigid and stiff.

14. The electrical connector (1) according to one of the preceding claims, wherein the mate-assist slider (30) comprises at least one cam slot (38) to receive at least one corresponding cam follower (70) of the counter connector (3).

15. The electrical connector (1) according to one of the preceding claims, wherein the electrical connector (1) is a High Density Connector (HDC) connector.


1
200
10
22
28
32
34
14
100
18
16
36
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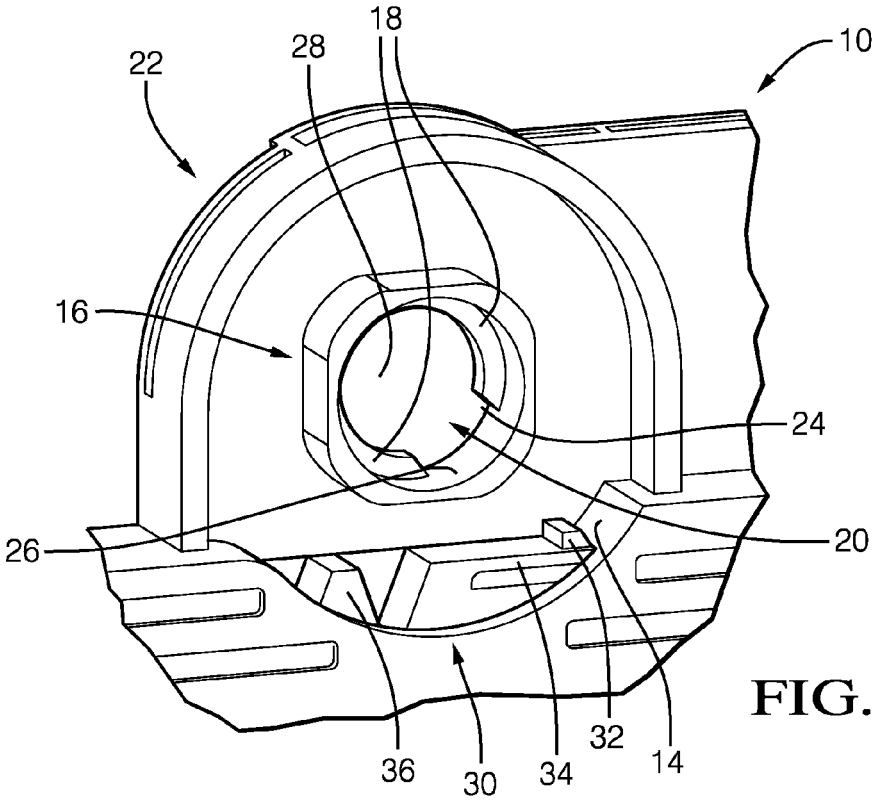
12
38
3
70

FIG. 1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32
14

FIG. 2

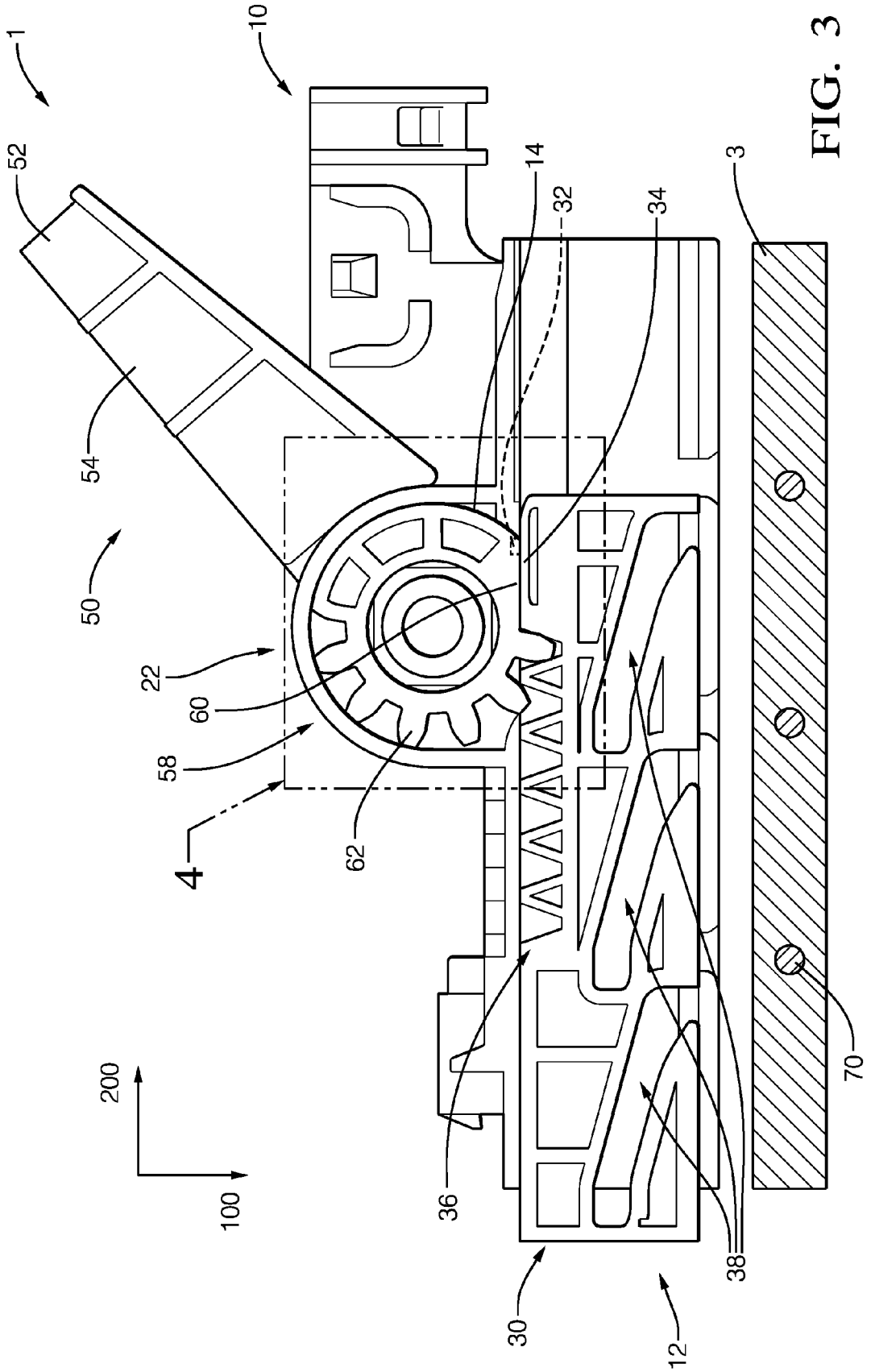

FIG. 3

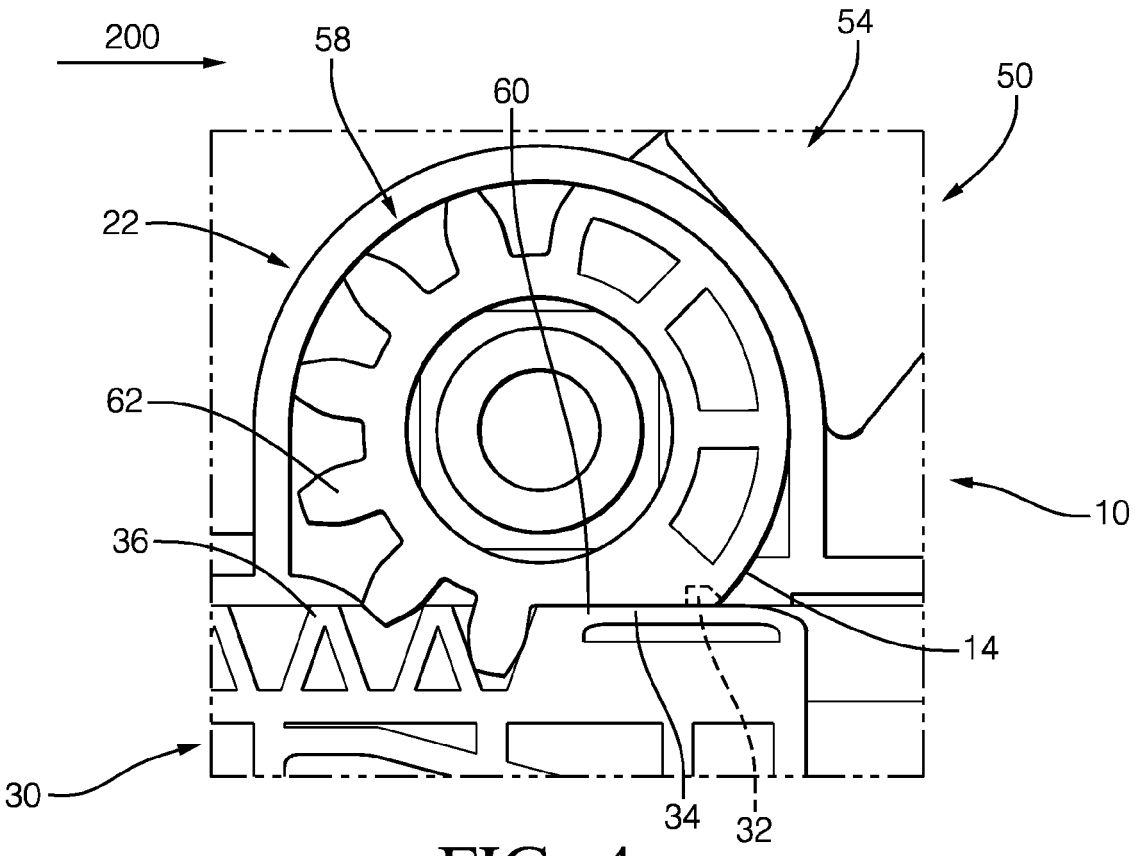

FIG. 4

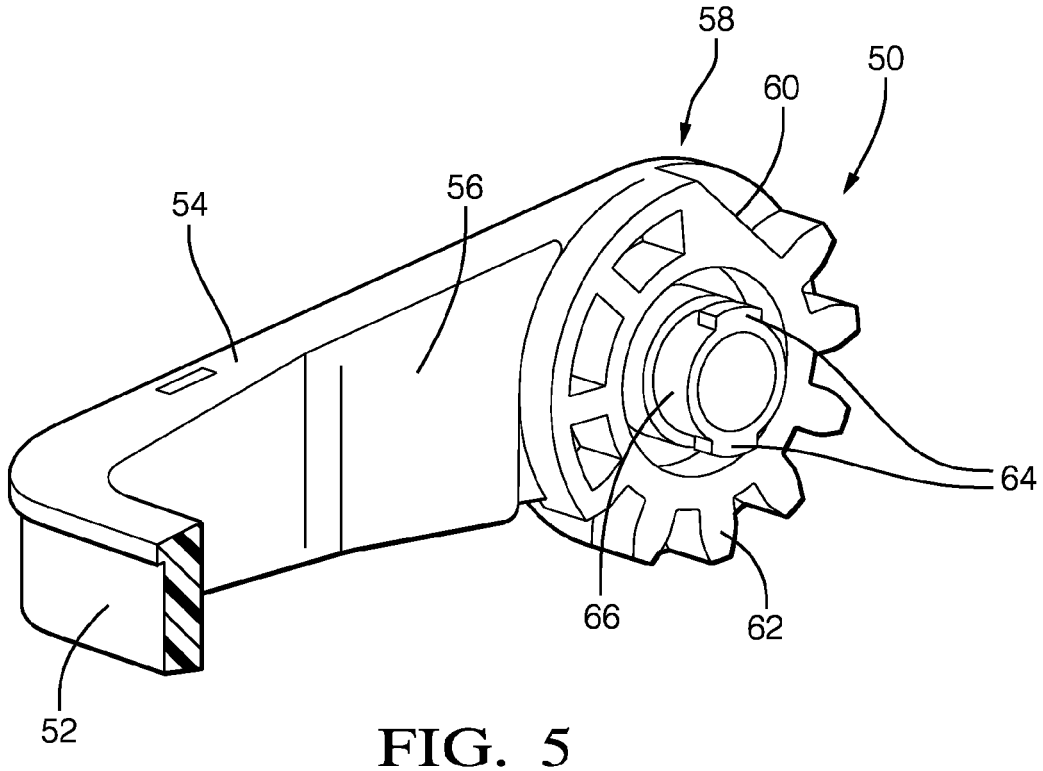

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 2492

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Place of search	Date of completion of the search	Examiner
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